

Ceramic Armor Apparatus for Multiple Bullet Protection

BACKGROUND OF THE INVENTION

Field of the Invention

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This invention relates to ceramic armor and, more particularly, to a single ceramic armor for protecting against multiple small arms bullets.

Description of the Prior Art

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Ceramic armor is typically used for body armor and for the outer coverings of different types of vehicles, such as various types of land vehicles, ships, and aircraft. Typically, ceramic tiles are adhesively secured to a substrate then encapsulated in an outer cover. The armor system is then attached to a vehicle by a variety of means or merely placed in a fabric pocket, as in the case of body armor.

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An inherent problem is the prior art is that ceramic armor is configured for a fixed level of protection against a singular ballistic threat.

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The apparatus of the present invention overcomes the deficiencies of the prior art by providing a single arrangement of ceramic and substrate to provide protection against a variety of bullets. The appropriate ceramic and substrate arrangement provides protection against both lead-filled and steel-filled bullets with calibers of 5.56mm and 7.62mm, which are the common calibers used by military and civilian rifles.

5 The apparatus may be used with or without a supplementary armor system such as a body armor vest or the outer skin of a vehicle. Stealth and other features, such as durability, drop protection, field abuse, spall mitigation, etc., may also be included in the apparatus.

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SUMMARY OF THE INVENTION

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The invention described and claimed herein comprises a Boron Carbide ceramic facing bonded to an Aramid fiber composite substrate. The ceramic facing element may consist of a plurality of elements, such as tiles, or may be a singular ceramic plate that is either flat or molded to the desired shape. The aramid fiber composite substrate is comprised of a plurality of layers of aramid fibers arranged in either fabric or uni-directional tape structures. The aramid fiber substrate layers are stacked to achieve the desired thickness and protection, and are laminated using a variety of polymer compounds to create a singular element. The aramid fiber substrate is arranged to be generally parallel to the ceramic facing element such that the shape of the aramid fiber substrate mirrors that of the ceramic element.

Among the objects of the following invention are the following:

To provide a new and useful means of protecting against ballistic attack;

25 To provide a new and useful means of arranging ceramic tile armor elements disposed on a substrate;

To provide a new and useful means of arranging a composite armor substrate in conjunction with a ceramic facing;

5 To provide a new and useful ceramic armor system for protection against multiple ballistic threats;

To provide a new and useful means of minimizing the weight of a ceramic armor system for ballistic protection; and

To provide a new and useful means of creating a supplementary armor plate for
10 use in conjunction with an existing armor system.

BRIEF DESCRIPTION OF DRAWING

DRAWING FIGURES

15 Figure 1 is a perspective view of an embodiment of the apparatus of the present invention.

Figure 2 is a view in partial section taken generally along line 2-2 of Fig 1.

Figure 3 is a perspective view of an alternate embodiment of the apparatus of the
20 present invention.

REFERENCE NUMERALS IN DRAWINGS

Item 10 is the ceramic armor apparatus

Item 11 is a ceramic armor assembly comprised of Items 12, 13, and 14

25 Item 12 is the monolithic ceramic facing element

Item 13 is the adhesive element

Item 14 is the aramid fiber substrate element

Item 15 is the encapsulating cover

Item 16 is the optional rear portion of the encapsulating cover

30 Item 17 is the ceramic tile facing element

Item 18 is the ceramic tile facing element

Item 19 is the ceramic armor assembly comprised of Items 13, 14, 17, and 18

Item 20 is the ceramic armor apparatus alternate embodiment

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DESCRIPTION OF PREFERRED EMBODIMENT

Figure 1 is a perspective view, partially broken away and in partial section, of the ceramic armor apparatus 10 of the present invention. Figure 2 is a view in partial section of the apparatus 10 taken generally along line 2-2 of Fig. 1. For the following discussion, reference will be made to Figs 1 and 2.

The ceramic armor apparatus 10 includes a cover 15 with the ceramic armor elements 11 deposited therein. The cover may include a back panel 16 that either partially or completely covers the rear surface of the plate. The cover may be comprised of a single material, such as nylon fabric, or may be a combination of fabric, rigid plastic, and foam that protects the ceramic from wear-and-tear and contains ceramic particles on impact as appropriate.

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~~Within the ceramic armor elements 11 is the ceramic tile element 12, the adhesive layer element 13, and the aramid fiber composite substrate element 14. The ceramic tile element 12 may be made of any appropriate non-oxide ceramic material, for example, Boron Carbide, Silicon Carbide ceramics. Alternatively, a ceramic matrix composite or metal matrix composite containing Silicon Carbide or Boron Carbide particles may be used. Although ceramic thickness may be varied to suit a specific need, the preferred ceramic arrangement ranges from 0.080-inches to 0.269-inches in thickness.~~

~~Disposed against and roughly parallel to back 12 is the adhesive element 13 that forms a discreet layer.~~

The adhesive layer 13 may be made of any approximate polymer, for example, epoxy, polyurethane, polysulfide, polyolefin. The preferred thickness of the adhesive

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5 layer is controlled to result in a thickness between 0.002-inches and 0.090-inches. For convenience, the adhesive layer illustrated in the drawing Figures are cross hatches as metal.

Inv. A4
104 ~~Disposed against the back 13, and roughly parallel to the back 12, is the aramid~~
fiber composite substrate plate 14.

10 The substrate plate 14 may be made of any appropriate aramid fiber such as Kevlar® or Twaron®. Aramid fiber constructions such as fabrics, unidirectional tapes, felts, non-woven layers, or three-dimensional structures may be used. The substrate layer 14 is arranged to create a uniform structure that ranges from 0.130-inches to 0.350-inches in thickness.

15 The aramid fibers of substrate plate 14 are encased in a polymer matrix to form a rigid laminate. Virtually any appropriate polymer resin may be used for the matrix, for example Phenolic, Phenolic Polyvinyl Butyral rubber blends, Polyester, Vinylester, polyurethane, and polyolefin resins. For convenience, the aramid fiber substrate plates illustrated in the drawing Figures are cross hatches as metal.

20 When substrate plate 14 employs a polymer resin matrix, the preferred resin content ranges from fifteen to twenty-four percent by weight.

An alternate embodiment 20 of the present invention is illustrated in Fig.3. Figure 3 comprises a perspective view, partially broken away and in partial section, of apparatus 20 of the present invention where the ceramic armor tile layer 19 comprises a
25 plurality of individual ceramic tiles as exemplified by elements 17 and 18. The ceramic elements 17 and 18 can be square ceramic tiles or otherwise shaped to suit the dimensional needs of a particular application.